

# **PEACEFUL USES OF NUCLEAR TECHNOLOGY: Summary of Issues**

**Workshop II,  
Atoms for Peace After 50  
Years**  
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# EISENHOWER VISION

- Seek the benefits of peaceful uses of atomic energy
- Allocate fissionable material for that purpose from a bank under international atomic energy agency control
- Provide conditions which will make fissionable material essentially immune to surprise seizure
  - Proceed without attempting to set up a completely acceptable system of world-wide inspection and control

# REALIZATION OF THE VISION?

## Benefits Achieved

- Major new combustion-free source of power to generate electricity
- Nuclear medical diagnosis and therapy applied widely
- Radioisotope applications ranging from non-destructive inspection to space power
  - Irradiation to improve agriculture and food

# REALIZATION OF THE VISION? Allocation of Fissile Material

- International banks not developed
- Fissile material initially provided by nuclear weapons states
  - Later, fissile material supplied through commercial arrangements, but restricted to peaceful uses
- Transfer of nuclear technology occurred in parallel, but restrictions on “sensitive technology” insufficient

# REALIZATION OF THE VISION?

## Materials immune to seizure

- Goal has been met to date as far as is known, but high concern on effectiveness of materials protection
- Large inventories of weapons-useable material worldwide; well-financed terrorists are a new threat
- Alternatives to seizure have been more effective to date: enriching and transmuting uranium to produce weapons grade material

# REALIZATION OF THE VISION?

## Inspection and Control

- A weakness in the vision but probably needed to gain initial support
  - IAEA, NPT, Safeguards system, UNMVIC established
  - Adequate system not achieved for non-signers of the NPT and rogue states
  - Terrorists pose a new challenge

# OVERALL REALIZATION OF THE VISION?

- Horizontal spread of nuclear weapons limited: 6 more nations compared to predictions of 50
- Nuclear weapons states' arms race halted; nuclear arms reductions
- Major benefits from nuclear technology
- Setbacks in past decade:
  - Major deficiencies revealed in inspection, export control, and compliance measures
  - More nations undertaking weapons development
  - Growth of peaceful applications slowed

# PROLIFERATION EXPERIENCED THROUGH CIVIL APPLICATIONS

- Uranium fuel enrichment
- Plutonium fuel separation
- Low power / low burnup reactors
- Nuclear power programs as cover for clandestine activities

# STRENGTHENING PROLIFERATION RESISTANCE

- Intrinsic features of power and “back-end” facilities necessary and could be improved--- but not sufficient
  - Institutional measures also needed
    - Materials accountability
  - Export controls
  - Inspections to verify compliance
    - Governance in event of non-compliance
- Integrated proliferation risk assessments can provide balance

# INTRINSIC IMPROVEMENTS

- Decrease weapons usability (grade and quantity,) of fuel enrichment and recycle products
- Increase difficulty of conversion and fabrication to weapons-usable form
- Utilize co-located facilities to increase security and accountability and minimize fuel transportation
- Increase ease of IAEA inspection
- Increase detectability of diversions
- Perform cost-benefit evaluations of improved intrinsic features

# EXTRINSIC IMPROVEMENTS

- Broad ratification of the “Additional Protocol” on inspection
- Further measures to strengthen IAEA inspection capability
- Strengthened protocols/standards on materials protection
- More effective governance of non-compliance
  - Revival and broadening of the “Eisenhower ‘bank’” concept

# **EXPANDING INTERNATIONAL BANK/SERVICE CONCEPTS**

- Regional spent fuel storage and disposition facilities
- International separated plutonium banks
- Regional "back end" fuel services
  - Enrichment
  - Fuel recycle (reprocessing and fabrication)

# NUCLEAR POWER AT PIVOTAL POINT?

- Expansion slowed: electric demand slowed; economics of new plants less favorable under deregulation
  - R&D programs reduced
- Terrorist threat to plant security
- But renewed interest as combustion-free generation with relatively stable and secure fuel supply

# RESPONSES TO DOWNSIDE ISSUES

**Economics:** Development of lower capital cost designs; impacts of fossil generator cost internalization; fuel supply uncertainties

**R&D:** Recent up-swing; U.S. Nuclear Power 2010 Initiative; Gen IV Effort

**Plant Security:** Regulations revamped, security increased; evaluations show relative robustness

# PROLIFERATION RISK IF NUCLEAR POWER DECLINES?

- Enrichment/separation can still be used to produce weapons materials
  - Large quantities of weapons-usable materials must still be protected from diversion
- Means of disposing of excess weapons plutonium are reduced
  - Proliferation resistance of widespread use of fuel recycle in the latter part of the century will need to be improved to permit deployment

# REDUCED/LOST BENEFITS IF NUCLEAR POWER DECLINES

- Safe and reliable electric generators
- A relatively stable and secure fuel supply
- An important element of diversity in electric generation
- Essentially no air polluting emission
- Potential for expanded applications
- But, need to be economically competitive

# APPLICATIONS IN MEDICINE, AGRICULTURE, INDUSTRY, AND RESEARCH REACTORS

- Substantial benefits to date
- Prospects for technology advancement good --- more public support
- Proliferation risks low

# CHALLENGES TO ADVANCEMENT

- Safe handling of radiological materials
- Accountability of sources
- Proliferation concern: highly enriched fuel in research reactors
- Potential use as RDDs by terrorists

# RESPONSES TO CHALLENGES

- Improvements and harmonization of regulations on safe handling
  - Resolve highly enriched fuel issue by conversion to low enrichments (complete RERTR program)
- Improved accountability and security of sources
  - Increased use of machine radiation sources

# THE CHALLENGE OF PUBLIC ACCEPTANCE

- A continuing constraining issue
- Not unusual for new technologies
- Fear of radiation, image of the bomb
- Power applications impacted more strongly but other applications affected, e.g. food irradiation
- Positive effect: highlights failures, focuses on prompt remediation
- Economics still dominant

# LEVEL OF ACCEPTANCE

- Variable over the years, hovering around the 50% level
- Severe accidents have major negative impact for years
  - High acceptance (75% level) as alternative for the future-----equal to solar
- Low acceptance as NIMBY (25% level), but higher than coal plants

# RESPONSE TO PUBLIC ACCEPTANCE

- Maintain and improve the present good record of safety and reliability, a necessary, if not sufficient, condition
  - Disclose safety issues fully, with prompt action to ascertain root causes and expedite remedies
- Implement spent fuel disposition
  - Serve power needs economically
  - Disseminate accurate information on progress and benefits